FURTHER EVIDENCE FOR GENDER DIFFERENCES IN CIRCULARVECTION

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Abstract — This paper reports further evidence that gender is a significant factor in the experience of circularvection (CV), the illusion of self-rotation. Using optokinetic drum velocities between 24° and 92°/s, latency to experience Stage 2 or Stage 3 CV was measured. Males exhibited significantly longer CV latencies than females (P < 0.0001), although the difference was greater for Stage 3 CV than for Stage 2 CV. This result suggests that the potential influence of gender must be carefully controlled in visual–vestibular interaction experiments. © 1998 Elsevier Science Inc.

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Introduction

Circularvection (CV) is an illusion of self-rotation caused by yaw rotation of the visual world around a stationary subject. Since CV and the associated optokinetic nystagmus are a result of the modulation of neurons in the vestibular nuclei and cortical vestibular areas by visual motion, CV represents a sensitive perceptual assay of visual–vestibular interaction. A distinction has been made between several different stages of CV (1). In the first stage ("egocentric motion perception"), the subject perceives the visual field as moving and himself or herself as stationary. In the second stage ("egocentric + exocentric motion perception"), the subject experiences self-motion in the direction opposite to that of the moving visual field. In the third and final stage of CV ("exocentric motion perception"), the subject experiences self-motion but perceives the visual stimulus to be stationary (1).

Although many studies of CV have shown that it is a variable phenomenon which can be influenced by factors such as age (2), very few studies have addressed the question of whether gender is a significant factor. In a recent study by Kennedy and colleagues (3), it was reported that males have a significantly longer latency to CV than females. Here we report that we have obtained the same result, which is robust across a range of velocities and different stages of CV.

Methods

A total of 32 subjects with no history of vestibular dysfunction were used in the present experiment. 13 males and 19 females, age range, 20 to 47 years; mean, 21 years.

CV was induced by seating subjects in an optokinetic drum that was 2 meters in diameter and 2 meters high. The interior of the drum was covered in black opaque plastic with vertical white stripes; the white stripes subtended 4°, and the black stripes 20°, of visual angle. Thus, the black and white vertical stripes completely filled the visual field. The drum was rotated around the subject in a counterclockwise direction using a DC motor; drum velocity could be...
selected (20° to 100°/s) using a dial in the control room. A tachometer attached to the drum enabled the experimenter to check drum velocity continuously during the experiment. On the basis of previous experiments, a trial interval of 30 s was chosen.

Subjects were seated in the center of the drum with the head resting against a back bar and the feet on a foot rest. They were read in...ust indicating that they were to "stare straight ahead at the stripes without attempting to follow them" and should press a button at the onset of either Stage 2 CV or Stage 3 CV (as defined previously). Subjects were instructed not to move the head under any circumstances.

Each subject (n = 32) received three, 30-s trials, corresponding to a high (92°/s), medium (63°/s) or low (24°/s) drum velocity for Stage 2 or Stage 3 CV (but not both). Each subject received only 3 trials in order to control for the effects of previous optokinetic experience on reaction time. The order of presentation of the 3 velocities was randomized. Before the beginning of the first trial and during each 1-min intertrial interval, the subject sat in darkness. Earphones delivered white noise during the experimental trials in order to mask auditory distractions. At each trial onset, the drum light, the earphones, and a digital timer were activated simultaneously for 30 s. The subject’s button press automatically stopped the digital timer, yielding a reaction time in seconds.

For some subjects, optokinetic nystagmus (OKN) was also recorded in order to ensure that the visual stimulus was sufficient to evoke OKN. In these cases, electrodes were attached to the outer canthus of each eye, and a ground electrode was placed in the center of the forehead. The output from the electrode leads was amplified and displayed on a polygraph.

The reaction time data were subjected to a logarithmic transformation, and two-factor analyses of variance with linear regression were performed. The significance rate was set at 0.05.

Results

Across the 3 velocities, males exhibited significantly longer latencies to CV than females (F(1, 28) = 31.2, P < 0.0001), although this difference was more noticeable for Stage 3 CV than for Stage 2 CV (see Figure 1).

Discussion

The results of the present experiment confirm and extend the finding of Kennedy and colleagues (3) that gender is a significant factor in latency to CV and that males exhibit a consistently longer latency to CV than females. In our experiment, we found that this difference in CV

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Figure 1. (A) latency to Stage 2 CV for male (n = 8) and female (n = 8) subjects exposed to a low (24°/s), medium (63°/s), or high (92°/s) velocity optokinetic stimulus; (B) latency to Stage 3 CV for male (n = 5) and female (n = 11) subjects exposed to a low (24°/s), medium (63°/s), or high (92°/s) velocity optokinetic stimulus. Bars represent 1 standard deviation of the mean.
Gender Differences in Circularvection

latency was maintained across the range of velocities of drum rotation; however, the latency difference between males and females was clearly greater for Stage 3 CV, in which subjects perceived self-rotation with a stationary visual field. In the experiment by Kennedy and colleagues, only one CV stage was used, which was approximately equivalent to our Stage 3 CV.

Kennedy and colleagues speculated that the difference in CV latency between males and females could be related to hormonal differences, since pharmacological studies have reported gender differences in vasopressin/oxytocin responses to illusory self-motion and nausea in humans (4). Another possibility is that the difference could be due to different reporting strategies; for example, males may be less inclined to admit that they are experiencing the illusion. However, Kennedy and colleagues also found that males exhibited a greater number of motion sickness symptoms than females, suggesting that there may be gender differences in visual–vestibular interaction itself.

Whatever the explanation for the influence of gender on latency to CV, our results and those of Kennedy and colleagues (3) suggest that failure to control for potential gender differences could have serious confounding effects in studies of human visual–vestibular interaction.

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REFERENCES